

Design Project #1

Replacement of Vehicle Bridge over Spring Creek

Centre County, PA

Introduction to Engineering Design

EDGSN 100 Section 002

"Good Enough" Design Team

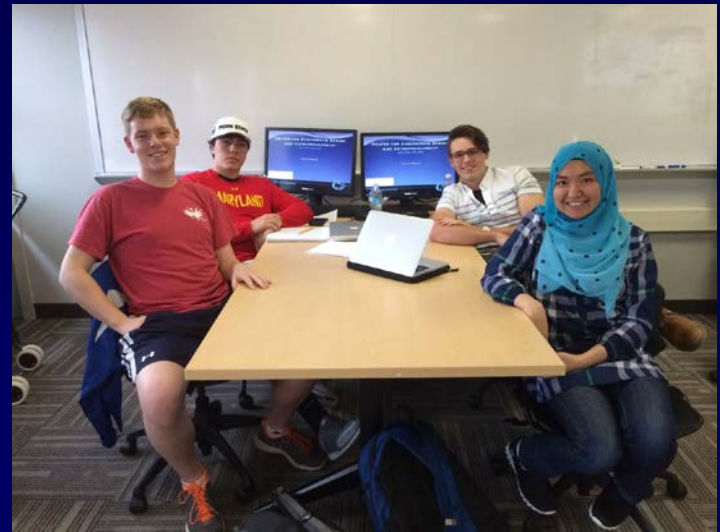
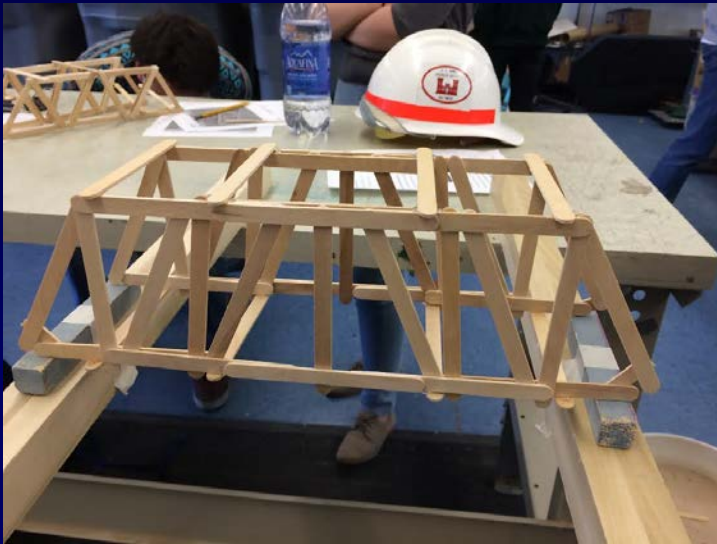
Design Team Number Three

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Presented to:
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Statement of Problem

- The bridge over Spring Creek along Puddintown Road has collapsed as a result of flooding
- Major route to Mount Nittany Medical Center
 - Speedy and sturdy solution needed



Objective

- A new bridge needs to be designed
- Structurally sound bridge so that future flooding will not destroy the bridge again.





Design Criteria

- The bridge will be a continuous span of 40 meters with no piers
- Deck will be made of medium strength concrete (0.23 m thick)
- The deck shall have an elevation of 20 meters
 - wide enough for two lanes of traffic.



Technical Approach Phase 1: Economic Efficiency

The economic efficiency of the bridge was determined by the EEBD software

- Included:
 - Material cost
 - Connection Cost
 - Product Cost
 - Site Cost – identical in all bridge designs



Technical Approach Phase 2: Structural Efficiency

- Determined by dividing the load the bridge supports at catastrophic failure by the weight of the prototype bridge
- $W_{\text{failure}}/W_{\text{bridge}} = \text{Structural Efficiency}$

Results Phase 1: Economic Efficiency

Howe:

Carbon Steel Tube: $\$6.30/\text{kg} \times 2,601.8\text{kg} = \$16,391.34$

Tempered Steel Bar: $\$6.00/\text{kg} \times 3,077.2\text{kg} = \$18,463.20$

Tempered Steel Tube: $\$7.70/\text{kg} \times 6,460\text{kg} = \$49,742.00$

Connection Cost: \$16,000.00

Product Cost: \$9,000.00

Site Cost: \$77,400.00

Total: \$186,996.14

Warren:

Carbon Steel Bar: $\$4.30/\text{kg} \times 6,054.0\text{kg} = \$26,032.20$

Carbon Steel Tube: $\$6.30/\text{kg} \times 1,049.8\text{kg} = \$6,613.74$

Tempered Steel Tube: $\$7.70/\text{kg} \times 9,303\text{kg} = \$71,633.10$

Connection Cost: \$16,800.00

Product Cost: \$12,000.00

Site Cost: \$77,400.00

Total: \$210,478.29

Results Phase 2: Structural Efficiency

Weight of Bridge/Load at Failure

Howe:

$$0.147\text{lbs} / 32.6\text{lbs} = 222$$

Warren:

$$0.161\text{lbs} / 48.2\text{lbs} = 299$$



Howe



Warren



Best Solution

- **Howe is \$23,482.15 cheaper than Warren**
- **Warren is over 1.3x more structurally efficient**
- **Bridge must withstand floodwaters**
 - Bridge chosen should be most structurally efficient
- **A Warren truss bridge is the best solution**



Conclusions

- **Warren truss bridge is more structurally efficient**
 - Slightly more expensive
- **Total Cost/Structural Efficiency**
 - Howe: $\$186,996.14/222 = 842$
 - Warren: $\$210,478.29/299 = 704$
 - Warren costs less per unit of S.E.
- **Tubular members are strong in compression**
- **Bars are strong in tension**

Recommendations

- A Warren through truss bridge should be built to span Spring Creek
- Quenched and tempered steel tubes are best material for members in compression

